

Guide for EMS: Quick Recognition of Toxic Agents in the Environment

General: It would be unlikely that only one person (victim) would be involved, more likely there would be multiple victims and there would likely be a difference in number of victims per area depending on distance from the probable source of the toxin. The farther one is from the source, the fewer casualties one would expect. Pets, stray or wild animals might also be effected so it would be important to take note of these as well as human victims. There may be odors apparent. With the exception of mustard blistering agents and radiation agents the effects would be seen immediately.

Cyanide: There may be no distinguishing physical findings or symptoms, particularly at low concentrations, rapid death at high concentrations.

Sudden collapse, convulsions or death after exposure, generally the victims are **acyanotic** (often retain the normal pink coloration until after death), there may be an odor of bitter almonds, often victims will complain of dizziness, weakness and anxiety.

Nerve Agents: Effects appear almost immediately, will vary from mild to very severe. There would likely be deaths near the source of the exposure

Sudden collapse, convulsions, muscle fasciculations (contractions), cyanosis, miosis (**small pupils**), there may be **shortness of breath**, cough, excess nasal secretions (**runny nose**), excess pulmonary secretions, salivation, urination, nausea, vomiting and diarrhea, other victims may complain of headache, muscle weakness, blurred or dimmed vision, there may be the odor of garlic or similar. There may be bradycardia (slow heart rate).

Caution: the classical SLUDGE, salivation, lacrimation, urination, defecation, gastroenteritis, or the other pneumonic DUMBBELS, defecation, urination, miosis, bronchospasm or bronchorrhea, emesis, lacrimation, salivation, was rarely seen in the Tokyo sarin attack.

Blister agents: Often no immediate effects, what immediate effects may occur usually **do not get better when the victim is removed from the site of exposure and may actually worsen.**

Sudden **irritation and pain in eyes**, on exposed skin, and airway (particularly in the nose and throat), there may also be burns of the skin or epistaxis (nosebleeds). After a delay the skin in the moist areas (e.g. armpits, around the genitals, etc.) of the body may become effected, skin may appear to have a sunburn or may look actually burned. There may be an odor of garlic. Caution: the effects of mustard agents may not be apparent for hours after exposure.

Choking agents: There will be **early irritation to eyes, nose and airways which will diminish with removal from the exposure site.**

Immediate irritation and pain to exposed eyes, skin, airways, there may be simple coughing, choking, or excess secretions such as those seen in pulmonary edema, i.e. clear or pink, frothy pulmonary secretions, there may be odors of freshly cut straw or grass

Radiation: The initial symptoms, if existent, are not specific, anorexia (loss of appetite), nausea and vomiting, transient waves of skin erythema (skin reddening) and conjunctivitis may become apparent.

Generally effects are related to dose and timing. Radiation dose drops off markedly by distance, the effects at 2 feet from a source is 1/4 of that at the source, at 4 feet is 1/16, at 8 feet 1/64, etc. Most often the effects will be delayed. The early effects from a nuclear device are more related to the mechanical effects (blast and heat)

In a high dose exposure nausea, vomiting and diarrhea within minutes of the exposure with ataxia (uncoordinated gait), disorientation, shock and coma

For Further Help call 1-800-222-1222

First Aid for EMS in Toxic Agent Exposures

General: It is imperative that the rescuer protect him/herself from exposure! In all potential “toxin” exposure the law of distance applies, get the victim as far away from the source of exposure in the fastest time as possible! Generally the dose of the toxin falls off rapidly with distance. Generally the treatment will be supportive and attention to the ABCs is important. Over treatment may produce problems as well as under treatment!

Cyanide: Time is of the essence, antidotal therapy is effective if administered early. Do not waste time with any efforts at decontamination, removal from exposure is sufficient decontamination for gas exposure anyway!

- Conscious, breathing: do not administer any antidote
- Unconscious, not breathing: crush an amyl nitrite ampule and put it into the mask of a bag ventilator and administer for 30 seconds every minute until IV access is achieved, then administer sodium nitrite from the cyanide antidote kit followed by the sodium thiosulfate. (give the full vial, 10 ml, IV over 5 minutes while monitoring for hypotension to an adult, ½ a vial to a 5-10 yo size child, ¼ of a vial in a child under 5 watching vital signs very closely to avoid overdosing a small child).

Nerve Agents: Time is of essence, if it is certain that exposure was to gas, not liquid, there is no need for decontamination. If there is a possibility of liquid, or droplet contamination then clothing should be removed but should not delay institution of antidotal therapy. If contamination from a liquid then decon must be started as soon as is feasible once the patient is stabilized.

- Conscious, breathing: if otherwise asymptomatic and only worried about exposure, do not administer antidote
- Conscious, breathing but symptomatic: if any difficult breathing e.g. wheezing, excess secretions, administer antidotal therapy: the atropine part of the Mark 1 kit or 2 mg of atropine (in a child give 0.1 mg to an infant, 0.5 mg up to 2 years, 1 mg from 2-10, above 10 treat as adult), repeat atropine every 3-5 minutes as needed. **Presence of tachycardia is not a contraindication for atropine!**
- Unconscious, convulsing or post-ictal (recovering from a convulsion), not breathing or with symptoms of two or more organs: administer atropine 4 mg immediately (in a child may use less but not less than 1 mg unless a very small child) repeat dose every 3-5 minutes

2-Pam, pralidoxime, to be administered when time allows, either as the second part of the Mark 1 kit or as a dose of 500 mg initially the 500 mg/hr

Blister Agents: It is unlikely that a symptomatic casualty will be encountered, therefore it is unlikely that any antidotal therapy will be needed. Treatment will consist of removal from the exposure site, decontamination as indicated and respiratory support as needed. Soothing lotions may be applied to irritated skin once decontamination has been completed.

Choking Agents There is no antidotal therapy available, attention to the respiratory symptoms and needs is imperative.

If there is certainty that exposure was to a gas, there is no need for decontamination. If there is a possibility of contamination by liquid, clothing must be removed and skin decontaminated with soap and water.

Radiation: Generally the victim is expected to be asymptomatic. Removal from the exposure source and attention to the physical injuries from the blast is paramount. Clothing should be removed with caution to avoid exposure to the rescuer and double bagged for determination of degree and type of exposure and then proper disposal. There is no specific antidote available in the field.

For further help call 1-800-222-1222!

More Specific Antidotal Information for Hospital Use

Atropine: there is really no “correct” dose! Dosage must be titrated to effect: drying of tracheal secretions, and resolution of broncho-constriction, and bradycardia. Atropine should be administered every 4-5 minutes until these end points are reached. Development of dilated pupils and tachycardia are NOT endpoints to use to stop atropinization! Unexposed patients exposed to these doses develop dilated pupils and tachycardias with heart rates well over 100 (usually increase of 35 bpm). Most of these effects dissipate in 4-6 hours but visual disturbances may last longer.

- Dose: preparations usually contain from 0.1 mg/ml to 1 mg/ml!, **check concentration carefully**; Mark 1 kits contain 2 mg in 0.7 ml
 - Pre-hospital
 - Adults should be given one injection intramuscularly of either Mark 1 autoinjector of atropine or 2 mg of commercial atropine every 2-5 minutes until pulmonary secretions are dry
 - Tachycardia and dilated pupils are not a contraindication to re-administration of atropine
 - Children above the age of 10 years should be treated as adults
 - Children less than 10 years of ages should be treated with intravenous, intraosseous or intramuscular atropine at an initial dose of 0.02 mg/kg with a minimum of 0.1 mg and up to 0.5 mg as the first dose.
 - If IV access is unavailable and the child is seriously ill, a single 2 mg IM dose of atropine would be acceptable.
 - Children less than 2 years of age should be initially dosed at 0.1 mg and titrated to effect
 - Once hospitalized and when intravenous access has been secured, atropine should be given IV starting with standard ACLS or PALS doses, and then doubled every 2-5 minutes until control is obtained.

Pralidoxime: the dosage schedule for pralidoxime is not well established. The drug must be given in sufficient dose to reverse the effects of cholinesterase inhibition but given in excess can lead to respiratory arrest as well.

- Pralidoxime (2PAM) commercially available preparations contain 1 gram per 20 ml vials, Mark 1 kits contain 600 mg in 2 ml auto injectors.
 - Indications
 - Any neuromuscular weakness.
 - More than a single dose of atropine may be required to control symptoms.
 - Dose:
 - Adults
 - Administer Mark 1 autoinjector or pralidoxime, IM every 2-5 minutes simultaneously with atropine as necessary up to 3 doses.
 - Children above age 10 can be treated as adults.
 - Smaller children should be treated intravenously if possible at a dose of 25-50 mg/kg up to 1-2 grams given as a 5% solution or less over no faster than 20-30 minutes.
 - If intravenous access is not available, a single 600 mg dose IM would be acceptable in any child above 10 kg.
 - Even smaller children may be treated based on the urgency.

- For all patients: Once intravenous access has been established, all patients should be treated IV at a dose of 25-50 mg/kg up to 2 grams in adults, given over no faster than 20-30 minutes. Many recommend 500 mg/hr in adults and 10-20 mg/kg/hr in children
- Benzodiazepines are indicated for all patients with seizures or signs of agitation as they have been shown to improve survival in animal models.
 - Standard doses of lorazepam or diazepam should be used.

Sodium nitrite: intravenous sodium nitrite is the currently preferred antidote in the face of apparent cyanide poisoning. Toxicity is related to hypotension and the production of methemoglobinemia. Methemoglobinemia **SHOULD NEVER BE REVERSED** when used to treat cyanide poisoning!

- If the patient has not responded to oxygen and amyl nitrite treatment, infuse sodium nitrite intravenously as soon as possible.
 - The usual adult dose is 10 mL of a 3% solution (300 mg) infused over **absolutely no less than 5 minutes**;
 - The average pediatric dose is 0.12 to 0.33 mL/kg body weight up to 10 mL infused as above.
 - Monitor blood pressure during sodium nitrite administration, and slow the rate of infusion if hypotension develops.
 - If the patient does not respond within 20-30 minutes of the first dose, based on correction of metabolic acidosis and production of a methemoglobin level of over 10%, a second dose may be administered at ½ the previous dose.

Sodium thiosulfate: if there is a mass casualty situation and there may be both a question of exact identification of the agent involved and difficulty with monitoring of all of the victims, it may be wise to use high flow oxygen, sodium bicarbonate treatment of acidosis and sodium thiosulfate in lieu of sodium nitrite. Thiosulfate is essentially non-toxic but some patients may develop nausea, vomiting and pain at the injection site.

- Infuse sodium thiosulfate intravenously.
 - The usual adult dose is 50 mL (one vial) of a 25% solution (12.5 g) infused over approximately 10 minutes;
 - If nitrites are not given, many authorities recommend that thiosulfate be infused more rapidly (over 2-5 minutes)
 - The average pediatric dose is 1.65 mL/kg of a 25% solution.
 - Repeat one-half of the initial dose 30 minutes later if there is an inadequate clinical response.

For Further Help Call 1-800-222-1222

Differentiation of Agents

Substance	Vital signs	Eyes	Chest	other
Cyanide	Early ↑ resp rate	Normal or dilated pupils	Clear early	Sudden collapse, convulsions, acyanotic
Nerve Agents	↓heart rate ↓→resp rate	Pinpoint pupils even in low light	Wheezes, rhonchi	↑ salivation, lacrimation, sweating, vomiting, diarrhea, convulsions
Choking agents	↑ resp rate	Burning, irritation	Cough, excess secretions	Odor: ammonia, straw/grass
Blister agents	↑→resp rate	Irritation	Irritation, cough	Delayed skin lesions, worsening of symptoms when leave the exposure site

Agent persistency in environment

The first step in treatment is removal of the victim from the exposure site. Depending on weather conditions the substance may persist in the environment and be considered a continued exposure threat. The following is the hierarchy of such persistency.

Substance by rank, most to least	Approximate persistency
Soman(GD)	Relatively persistent in soil, unknown on clothing
VX	2-6 days in soil, persistent on clothing
Tabun	1-1.5 days in soil, unknown on clothing
Mustard	Impure(H): persistent in soil, hrs to days on clothing Distilled (HD): 2 weeks-3 yrs in soil, hrs to days on clothing
Lewisite	In soil; days, on clothing hrs to days
Sarin	In soil 2-24 hrs, unknown on clothing
Cyanide	In soil < 1 hr, none on clothing
Phosgene	In soil 2 hrs, non-persistent on clothing
Chlorine	Essentially none depending on wind